Document Title	Specification of Hardware Test Manager on start up and shutdown
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	703

Document Status	published
Part of AUTOSAR Standard	Classic Platform
Part of Standard Release	R24-11

Document Change History

Date	Release	Changed by	Description
2024-11-27	R24-11	AUTOSAR Release Management	• No content changes
2023-11-23	R23-11	AUTOSAR Release Management	• No content changes
2022-11-24	R22-11	AUTOSAR Release Management	• No content changes
2021-11-25	R21-11	AUTOSAR Release Management	• No content changes
2020-11-30	R20-11	AUTOSAR Release Management	• Chapter 7.3.1 generated from BSW UML model • Chapter 7.1 structure updated
2019-11-28	R19-11	AUTOSAR Release Management	• Chapter 8 generated from BSW UML model • Changed Document Status from Final to published
2018-10-31	4.4.0	AUTOSAR Release Management	• Headerfile cleanup
2016-11-30	4.3.0	AUTOSAR Release Management	• Initial Release

Disclaimer

Contents

1 Introduction and functional overview

This specification describes the concept, interfaces and the configuration of the module Hardware Test Management start up and shutdown (HTMSS).

The module HTMSS [1] is a basic software module at the service layer of the standardized basic software architecture of AUTOSAR.

The HTMSS [1] module shall provide the test status/results for the application SWC usages.

The purpose of this module is to provide an infrastructure for integrating/transforming the microcontroller manufacturer specific start up and shutdown tests (e.g. BIST) test results/status within the AUTOSAR standard software platform.

The basic functionalities of this module includes collecting the test results/status from the MSTP, configure MSTP tests, start tests execution, provide the MSTP test status to EcuM module and application SWC to evaluate the test results for the system behavior.

The HTMSS [1] module integrates on the level of the AUTOSAR BSW service layer. Below figure shows the functional integration of the HTMSS [1] module in AUTOSAR software platform.

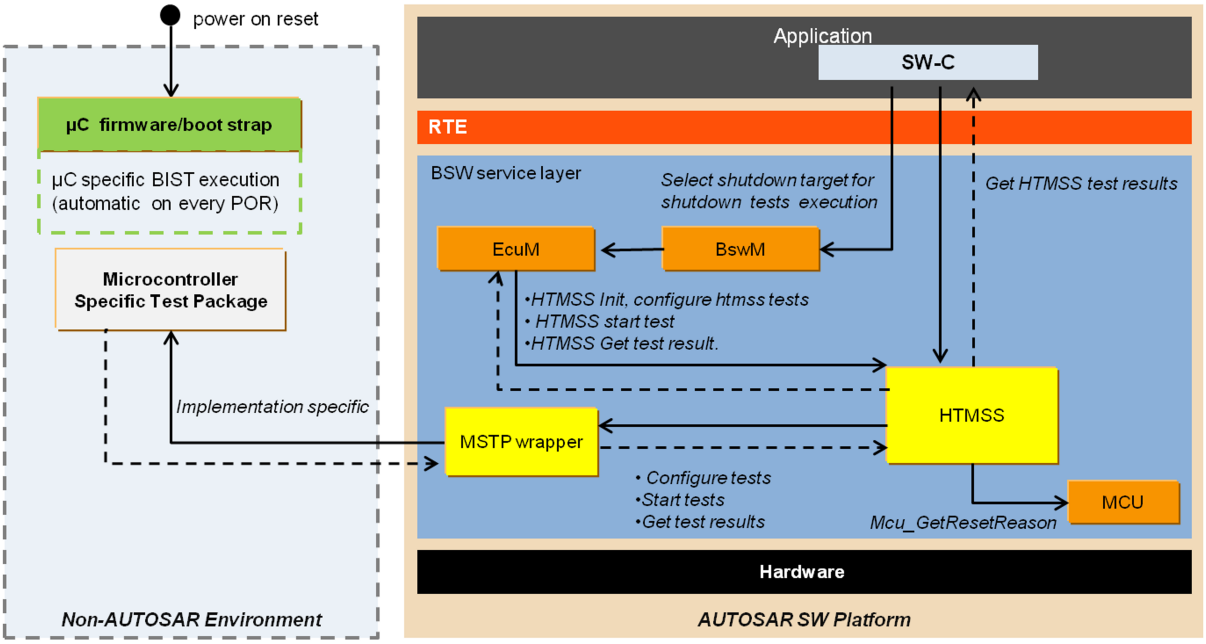


Figure 1.1: HTMSS interaction overview

Note: MSTP wrapper is an intermediate module for accessing the MSTP module from an AR standardized module HTMSS. The MSTP wrapper can be implemented manually or can be generated/configured using AUTOSAR methodology/process.

The HTMSS module pre-integration requirements are:

- It shall be possible to run Microcontroller Specific Test Package (MSTP) startup and shutdown tests on the device under development
- The test results/status are available to the HTMSS module access
- It shall be possible to configure the MSTP start up and shutdown tests via HTMSS module

The role of HTMSS module in different phases of the standard AUTOSAR software execution platform is depicted below.

Note: The HTMSS concept may be considered for integration in AUTOSAR architecture to achieve safety goals for a safety relevant ECU, but it is NOT mandatory always.

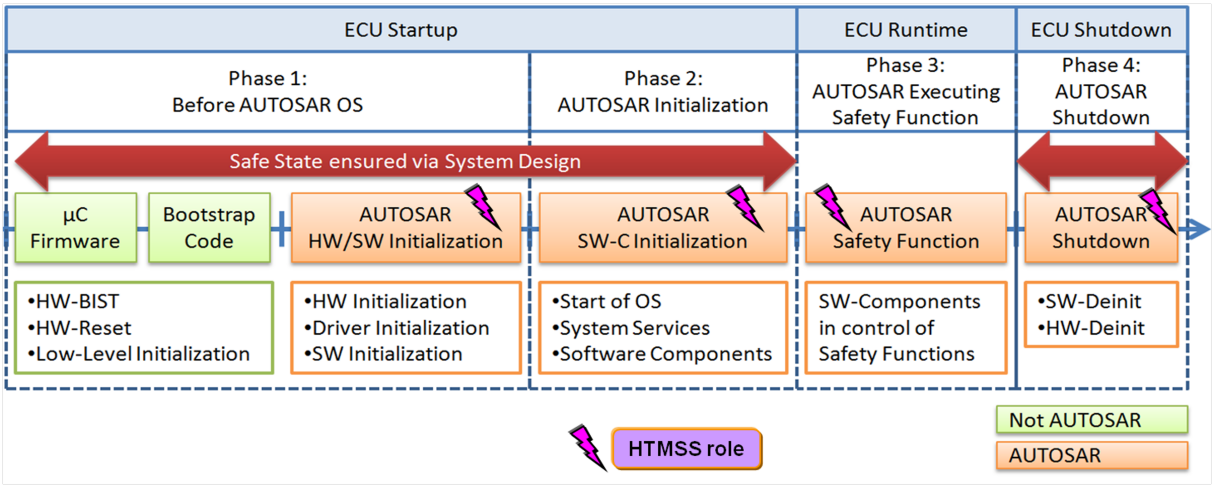


Figure 1.2: HTMSS phases overview

Note: The HTMSS phases described below are for explaining the functionalities of HTMSS module in a typical AUTOSAR ECU software execution environment. These phases shall NOT be referred to the phases defined in EcuM [2].

HTMSS Phase 1 Before AUTOSAR OS [3] - This phase is delimited by the MCU reset to the call to StartOS() function. During this state there a wide range of possibilities for execution of various types of tests. The MCU periphery and AUTOSAR is not initialized at first, this provides potential opportunity for executing destructive tests, MCU built-in tests, fault injection tests etc. That phase is also used to evaluate the results obtained by tests during shutdown phase, through the reset logic.

During AUTOSAR HW/SW Initialization by EcuM_Init(), it is possible to execute further diagnostic tests within the AUTOSAR context. Rather non-destructive tests can be executed within EcuM [2].

The HTMSS will be fully available at the end of Phase 2, since it requires integral parts of AUTOSAR to be executed as a System Service.

HTMSS Phase 2 AUTOSAR OS and SW-C initialization - the phase is delimited by the start of AUTOSAR OS [3] using the function call StartOS() until the complete AUTOSAR is initialized including application software components.

During this phase, the diagnostic test results can be provided by HTMSS and consumed by Safety SW-C for further decisions.

HTMSS Phase 3 AUTOSAR executing safety function - During this phase, the system has started the intended functionality and safety function is part of it. The phase is suitable for monitoring mechanisms accommodation as well as some built-in diagnostic mechanisms, which could be single or latent fault contributors - ECC fault detection mechanisms, ADC operational capabilities etc. The HTMSS concept does not support Runtime Tests yet (which is a different set of tests), therefore HTMSS can only provide test results from the previously executed Startup and Shutdown tests during Phase 3.

HTMSS Phase 4 AUTOSAR shutdown. This phase offers a possibility to execute tests, which are not preferable to be executed at any other phase (for example the execution time is too long) and which are able to communicate their results over an MCU reset. The results can be evaluated during a subsequent MCU startup.

2 Acronyms and Abbreviations

The glossary below includes acronyms and abbreviations relevant to the HWTestManager module that are not included in the [4, AUTOSAR glossary].

Abbreviation / Acronym:	Description:
ADC	Analog to Digital converter
BIST	Built In Self Test
BSW	Basic Software
DET	Default error tracer
ECU	Electronic Control Unit
ECUM	Electronic Control Unit Manager
HTMSS	Hardware Test Management startup shutdown
MCU	Micro Controller Unit
MSTP	Microcontroller Specific Test Package
RTE	Run Time Environment

Table 2.1: Acronyms and abbreviations used in the scope of this Document

3 Related documentation

3.1 Input documents & related standards and norms

[1] Specification of Hardware Test Manager on start up and shutdown
AUTOSAR_CP_SWS_HWTestManager

[2] Specification of ECU State Manager
AUTOSAR_CP_SWS_ECUStateManager

[3] Specification of Operating System
AUTOSAR_CP_SWS_OS

[4] Glossary
AUTOSAR_FO_TR_Glossary

[5] General Specification of Basic Software Modules
AUTOSAR_CP_SWS_BSWGeneral

[6] Layered Software Architecture
AUTOSAR_CP_EXP_LayeredSoftwareArchitecture

[7] Specification of RTE Software
AUTOSAR_CP_SWS_RTE

3.2 Related specification

AUTOSAR provides a General Specification on Basic Software modules [5, SWS BSW General], which is also valid for HWTestManager.

Thus, the specification SWS BSW General shall be considered as additional and required specification for HWTestManager.

4 Constraints and assumptions

This document is applicable for AUTOSAR release 4.3.0

4.1 Limitations

The use of this module is optional and only in case where the provided functionality is required.

To integrate needed range of testing capabilities for specific solution, it has required that all affected modules need to implement interfaces with HTMSS.

Example: The MSTP (microcontroller specific test package) module from the semi manufacturer is a mandatory module for integrating the HTMSS module in AUTOSAR software platform

The start up/shutdown test configurations are up to the system integrator and based on the MSTP test configuration capabilities and features.

The module HTMSS shall interact with the assumed test module (MSTP) via a wrapper implementation (in this spec named as MSTP wrapper) using AR methodology/process.

The test results storage in NV memory and DEM error reporting requirements are out of scope from HTMSS module. Integrator shall manage these requirements at respective application SWC level, if needed.

4.2 Applicability to car domains

Each ECU is designed to provide predefined functionality in the context of given system architecture. Then it is of great importance that this ECU operates without failures, which in turn can be avoided or detected before they appear, by simple monitoring of expected faults. One strategy to check the operability of ECU is to execute destructive tests (during start up and shutdown of ECU) that check the given logic and conditions, and keep the results for further analysis. The HTMSS module depicts the need to address results from such tests on ECU, and to provide their status on request.

5 Dependencies to other modules

The HTMSS has interfaces to some BSW Modules [5] and application SWC in the AUTOSAR architecture [6]. Additionally HTMSS has interfaces with Microcontroller Specific Test Package (MSTP) outside the AUTOSAR architecture. However, the interactions with MSTP are implementation specific.

5.1 EcuM

The ECU State Manager [2] shall access the HTMSS services to start the tests, and collect test results/status from the device under test.

The ECUM STARTUP phase and SHUTDOWN phase incorporates the main functionalities of HTMSS module in AUTOSAR software platform.

5.2 Application SWC

The application software component shall collect the HTMSS test results (via RTE [7]) for evaluations and then to determine the software behavior. Additionally, if needed the test results shall be stored in the non-volatile memory for later use.

5.3 RTE

Through the RTE [7] data exchange the test result/status are shared between the HTMSS module and the application software layer.

5.4 Dependencies with MSTP

The HTMSS [1] may access the MSTP module (could be a non-AR software module, being synchronous and/or asynchronous) to manage the below functionalities/ features within the AUTOSAR software platform.

- To configure the start up and shutdown tests configured in the HTMSS module
- To trigger the MSTP tests during the ECUM start up and shutdown phases
- To collect the test results and provide to application software for its usage

Note: HTMSS module shall interact with MSTP module through wrapper module/-source code (named in this spec MSTP wrapper) configurated/generated using AUTOSAR methodology and process.

5.5 MCU

The HTMSS receives the reset reason from the MCU driver (e.g. reset caused by shutdown tests execution)

5.6 Default Error Tracer (Det)

If the DET is enabled, the HTMSS module informs the Default error tracer about the detected development errors.

5.7 File structure

5.7.1 Code file structure

[SWS_HTMSS_00001]

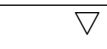
Upstream requirements: SRS_BSW_00346

⌈The code file structure shall contain one or more source files HTMSS_<xxx>.c, which contains the entire parts of the HTMSS code.⌋

6 Requirements Tracing

The following tables reference the requirements specified in [5] and links to the fulfillment of these. Please note that if column “Satisfied by” is empty for a specific requirement this means that this requirement is not fulfilled by this document.

Requirement	Description	Satisfied by
[SRS_BSW_00159]	All modules of the AUTOSAR Basic Software shall support a tool based configuration	[SWS_HTMSS_00016]
[SRS_BSW_00301]	All AUTOSAR Basic Software Modules shall only import the necessary information	[SWS_HTMSS_00012]
[SRS_BSW_00323]	All AUTOSAR Basic Software Modules shall check passed API parameters for validity	[SWS_HTMSS_00038]
[SRS_BSW_00337]	Classification of development errors	[SWS_HTMSS_00011]
[SRS_BSW_00345]	BSW Modules shall support pre-compile configuration	[SWS_HTMSS_00006] [SWS_HTMSS_00016]
[SRS_BSW_00346]	All AUTOSAR Basic Software Modules shall provide at least a basic set of module files	[SWS_HTMSS_00001]
[SRS_BSW_00384]	The Basic Software Module specifications shall specify at least in the description which other modules they require	[SWS_HTMSS_00040]
[SRS_BSW_00386]	The BSW shall specify the configuration and conditions for detecting an error	[SWS_HTMSS_00029] [SWS_HTMSS_00037]
[SRS_BSW_00404]	BSW Modules shall support post-build configuration	[SWS_HTMSS_00015]
[SRS_BSW_00407]	Each BSW module shall provide a function to read out the version information of a dedicated module implementation	[SWS_HTMSS_00039]
[SRS_BSW_00480]	Null pointer errors shall follow a naming rule	[SWS_HTMSS_00024]
[SRS_HTMSS_00001]	The HTMSS shall allow configuration of start up and shutdown tests	[SWS_HTMSS_00014] [SWS_HTMSS_00017] [SWS_HTMSS_00018] [SWS_HTMSS_00023] [SWS_HTMSS_91006] [SWS_HTMSS_91007] [SWS_HTMSS_91008] [SWS_HTMSS_91009]
[SRS_HTMSS_00002]	The HTMSS shall allow the configuration of tests at individual hardware resource level	[SWS_HTMSS_00008] [SWS_HTMSS_00009] [SWS_HTMSS_00014] [SWS_HTMSS_00017] [SWS_HTMSS_00018] [SWS_HTMSS_00022] [SWS_HTMSS_91006] [SWS_HTMSS_91007] [SWS_HTMSS_91008] [SWS_HTMSS_91009]
[SRS_HTMSS_00003]	The HTMSS shall provide a service to collect the MSTP tests results	[SWS_HTMSS_00005] [SWS_HTMSS_00010] [SWS_HTMSS_00032] [SWS_HTMSS_00033] [SWS_HTMSS_00034] [SWS_HTMSS_00035] [SWS_HTMSS_00036]
[SRS_HTMSS_00004]	The HTMSS shall provide a mechanism to share the test results with the application layer software	[SWS_HTMSS_00031] [SWS_HTMSS_00032] [SWS_HTMSS_00042]
[SRS_HTMSS_00005]	The HTMSS shall provide a service to configure/Initialise the MSTP tests during ECUM start up phase	[SWS_HTMSS_00019] [SWS_HTMSS_00020] [SWS_HTMSS_00021] [SWS_HTMSS_00030]



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Requirement	Description	Satisfied by
[SRS_HTMSS_00006]	The HTMSS shall provide a service to trigger the tests execution	[SWS_HTMSS_00025] [SWS_HTMSS_00026] [SWS_HTMSS_00027] [SWS_HTMSS_00028] [SWS_HTMSS_00030]
[SRS_HTMSS_00007]	HTMSS shall provide callout options to handle the test failure conditions	[SWS_HTMSS_00043] [SWS_HTMSS_00044]

Table 6.1: Requirements Tracing

7 Functional specification

7.1 General behavior

The basic functionalities of HTMSS can be divided into the following main groups:

- Initialization of HTMSS module
- Configure the MSTP tests based on HTMSS configuration (start up/shutdown)
- Interface for starting the MSTP tests (startup and shutdown)
- Provide the MSTP tests status to the other autosar modules (incl. appln SWC)

Note: The HTMSS shall not add any test functionality corresponding to MSTP tests. The tests implementation and execution is out of HTMSS scope.

7.2 Hardware Test Management

7.2.1 Background & Rationale

The overall objective is to provide a fault status of the microcontroller operation by means of hardware test execution in safety-related systems, built on standard AUTOSAR platform.

The concept shall provide a facility to execute and log a predefined set of tests. Additionally shall support HW monitoring activities in the context of microcontroller in use, obtain tests results and propagate them to stakeholder software components in AUTOSAR environment.

The goal of HTMSS module is to standardize the accessible interfaces that can perform the microcontroller specific start up/shutdown tests outside the AUTOSAR environment and then to collect & evaluate the test results within AUTOSAR software execution context.

7.2.2 Requirements

[SWS_HTMSS_00005]

Upstream requirements: SRS_HTMSS_00003

⌈The HTMSS shall be able to read the microcontroller specific start up and shutdown test results/status, on the requested hardware.⌋

Note: It is the responsibility of user/integrator to evaluate the HTMSS provided start up and shutdown test results (i.e. in case of failure) and then to define the software reactions. The error hooks (start up & shutdown) shall evaluate the test results.

HINT: Integrator may have prioritised the tests handling the test results based on the criticality/relevance in the system/safety goals etc. In case of a critical error integrator shall decide to go back to reset state or shutdown sate.

[SWS_HTMSS_00006]

Upstream requirements: SRS_BSW_00345

⌈The pre-compile time configuration parameters shall be checked statically (at least during compile time) for correctness.⌋

[SWS_HTMSS_00008]

Upstream requirements: SRS_HTMSS_00002

⌈In one configuration, there shall be more than one test per module for testing. These tests could be executed in parallel.⌋

Note: The configuration parameter to handle above requirement shall be adapted in HTMSSConfigSet Section 10.1.3

[SWS_HTMSS_00009]

Upstream requirements: SRS_HTMSS_00002

⌈It shall be possible to test the individual hardware resources (e.g. selected via module / channel ID) on the given hardware.

HINT: A microcontroller may contain two hardware unit for the ADC peripheral. There shall be a support to test / obtain test results for each ADC unit individually.

Note: There can be no guarantee that errors in unused hardware resources do not propagate or have influence on the rest of the microcontroller. Therefore, a complete hardware tests may need to be executed and the test results shall be considered appropriately based on the safety requirements of the ECU.⌋

Refer Section 10.1.3 HTMSSConfigSet for configuration parameter implementations.

7.2.3 States of HTMSS module

[SWS_HTMSS_00010]

Upstream requirements: SRS_HTMSS_00003

⌈

State	Description
HTMSS_UINIT	HTMSS module uninitialized(default value before module initialization)
HTMSS_INIT	HTMSS module initialized
HTMSS_BUSY	The HTMSS requested tests are not completed/progressing/initiated
HTMSS_IDLE	HTMSS requested tests are completed/ NO pending tests are running

⌋

7.3 Error Classification

Section "Error Handling" of the document [5] "General Specification of Basic Software Modules" describes the error handling of the Basic Software in detail. Above all, it constitutes a classification scheme consisting of five error types which may occur in BSW modules.

Based on this foundation, the following section specifies particular errors arranged in the respective subsections below.

7.3.1 Development Errors

[SWS_HTMSS_00011] Definiton of development errors in module HTMSS

Upstream requirements: SRS_BSW_00337

⌈

Type of error	*Related error code*	*Error value*
A service was called prior to initialization	HTMSS_E_NOT_INIT	0x01
A null pointer was passed as an argument	HTMSS_E_NULL_POINTER	0x02
A parameter was invalid (unspecific)	HTMSS_E_PARAM_INVALID	0x03
Function called when test request is running	HTMSS_E_BUSY	0x04

⌋

7.3.2 Runtime Errors

There are no runtime errors.

7.3.3 Production Errors

There are no production errors.

7.3.4 Extended Production Errors

There are no extended production errors.

7.4 Security Events

The module does not report security events.

8 API specification

8.1 Imported types

In this chapter, all types included from the following files are listed:

The HTMSS shall use only the following imported types of other modules:

[SWS_HTMSS_00012] Definition of imported datatypes of module HTMSS

Upstream requirements: SRS_BSW_00301

⌈

Module	*Header File*	*Imported Type*
Mcu	Mcu.h	Mcu_ResetType
Std	Std_Types.h	Std_ReturnType
	Std_Types.h	Std_VersionInfoType

⌋

8.2 Type definitions

The following Data Types shall be used for the functions defined in this specification

8.2.1 HTMSS_TestCfgType

[SWS_HTMSS_91006] Definition of datatype HTMSS_TestCfgType

Upstream requirements: SRS_HTMSS_00001, SRS_HTMSS_00002

⌈

Name	HTMSS_TestCfgType	
Kind	Structure	
Elements	Implementation specific	
	Type	–
	Comment	The content of the configuration data structure is implementation specific.
Description	Configuration data structure of HTMSS module	
Available via	HTMSS.h	

⌋

8.2.2 HTMSS_TestStatusType

[SWS_HTMSS_91009] Definition of datatype HTMSS_TestStatusType

Upstream requirements: SRS_HTMSS_00001, SRS_HTMSS_00002

⌈

Name	HTMSS_TestStatusType		
Kind	Enumeration		
Range	HTMSS_STATUS_OK	–	Test status PASS
	HTMSS_STATUS_NOK	–	Test status FAIL
	HTMSS_STATUS_INVALID	–	Test status is Invalid
	HTMSS_STATUS_UNINIT	–	Test status is not initialized
Description	HTMSS_TestStatusType describes status of test.		
Available via	HTMSS.h		

⌋

8.2.3 HTMSS_TestGroupType

[SWS_HTMSS_91007] Definition of ImplementationDataType HTMSS_TestGroup Type

Upstream requirements: SRS_HTMSS_00001, SRS_HTMSS_00002

⌈

Name	HTMSS_TestGroupType		
Kind	Enumeration		
Range	HTMSS_STARTUP	–	Test to be executed at startup only
	HTMSS_SHUTDOWN	–	Test to be executed at shutdown only
	HTMSS_STARTUP_ SHUTDOWN	–	Test to be executed at start up and shutdown
Description	HTMSS_ TestGroupType describes the test group type		
Variation	–		
Available via	HTMSS.h		

⌋

8.2.4 HTMSS_TestResultType

[SWS_HTMSS_91008] Definition of ImplementationDataType HTMSS_TestResultType

Upstream requirements: SRS_HTMSS_00001, SRS_HTMSS_00002

⌈

Name	HTMSS_TestResultType	
Kind	Structure	
Elements	TestResult	
	Type	uint8
	Comment	The test result (e.g. pass, fail, invalid)
	TestSignature	
	Type	uint8
	Comment	The identifier of the tested resource
Description	It describes the current test result	
Variation	–	
Available via	HTMSS.h	

⌋

8.3 Function definitions

The following sections specify the provided API functions of the HTMSS module.

8.3.1 HTMSS_Init

[SWS_HTMSS_00014] Definition of API function HTMSS_Init

Upstream requirements: SRS_HTMSS_00001, SRS_HTMSS_00002

⌈

Service Name	HTMSS_Init	
Syntax	`void HTMSS_Init ( const HTMSS_TestCfgType* ConfigPtr )`	
Service ID [hex]	0x01	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	ConfigPtr	Pointer to configuration set in Variant PB (Variant PC requires a NULL_PTR).
Parameters (inout)	None	

▽

△

Parameters (out)	None
Return value	None
Description	Initializes the HTMSS module
Available via	HTMSS.h

⌋

[SWS_HTMSS_00015]

Upstream requirements: SRS_BSW_00404

⌈In case of Variant PB: The function `HTMSS_Init` shall initialize the HTMSS module and according to the configuration set referenced by `ConfigPtr`.⌋

[SWS_HTMSS_00016]

Upstream requirements: SRS_BSW_00345, SRS_BSW_00159

⌈In case of Variant PC: The function `HTMSS_Init` shall initialize the HTMSS according to the pre-compile configuration set.⌋

[SWS_HTMSS_00017]

Upstream requirements: SRS_HTMSS_00001, SRS_HTMSS_00002

⌈The service `HTMSS_Init` shall initialize the global variables and data structures of the HTMSS including flags and buffers.⌋

[SWS_HTMSS_00018]

Upstream requirements: SRS_HTMSS_00001, SRS_HTMSS_00002

⌈The function `HTMSS_Init` shall initialize MSTP module and configure the MSTP tests.⌋

[SWS_HTMSS_00019]

Upstream requirements: SRS_HTMSS_00005

⌈The HTMSS is not functional until this function has been called.⌋

[SWS_HTMSS_00020]

Upstream requirements: SRS_HTMSS_00005

⌈The function `HTMSS_Init` shall determine the last reset reason by calling the Mcu_GetResetReason of the MCU driver.⌋

[SWS_HTMSS_00021]

Upstream requirements: SRS_HTMSS_00005

⌈The function `HTMSS_Init` shall configure the MSTP tests (both start up and shutdown), if the last reset reason is not `MCU_HWTEST_RESET`.⌋

[SWS_HTMSS_00022]

Upstream requirements: SRS_HTMSS_00002

⌈The function `HTMSS_Init` shall configure the start up and shutdown tests individually.

Hint: The interfaces and test configurations with MSTP module are implementation specific. There may be some cases to configure the same type of tests for execution in both start up and shutdown slots. `HTMSS_TestGroupType` can be used in this context.⌋

[SWS_HTMSS_00023]

Upstream requirements: SRS_HTMSS_00001

⌈The function `HTMSS_Init` shall set the HTMSS state to `HTMSS_UNINIT`, if the configuration of MSTP tests fails for any reason.⌋

[SWS_HTMSS_00024]

Upstream requirements: SRS_BSW_00480

⌈If DET for the HTMSS is enabled: the function `HTMSS_Init` shall check for valid pointer. In case of an error, `HTMSS_Init` shall raise the development error `HTMSS_E_NULL_POINTER`.⌋

8.3.2 HTMSS_StartTest

[SWS_HTMSS_00025] Definition of API function HTMSS_StartTest

Upstream requirements: SRS_HTMSS_00006

⌈

Service Name	HTMSS_StartTest	
Syntax	`Std_ReturnType HTMSS_StartTest ( HTMSS_TestGroupType GrpId )`	
Service ID [hex]	0x03	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	GrpId	The test group type (e.g. start up or shut down)

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△

Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	Standard return from function execution
Description	Starts the MSTP configured tests	
Available via	HTMSS.h	

⌋

[SWS_HTMSS_00026]

Upstream requirements: SRS_HTMSS_00006

⌈The function `HTMSS_StartTest` shall trigger the MSTP test operation on the requested hardware. If this is successful, E_OK shall be returned.⌋

[SWS_HTMSS_00027]

Upstream requirements: SRS_HTMSS_00006

⌈The function `HTMSS_StartTest` shall set the HTMSS state to `HTMSS_BUSY`, if the MSTP status confirm that, test trigger is successful.⌋

[SWS_HTMSS_00028]

Upstream requirements: SRS_HTMSS_00006

⌈The function `HTMSS_StartTest` shall handle the start up and shutdown test requests for the device under test.

Hint: The interface between HTMSS and the MSTP module is implementation specific. Because the semi manufacturer may define the method of interacting with MSTP module for the device.⌋

[SWS_HTMSS_00029]

Upstream requirements: SRS_BSW_00386

⌈If DET for the HTMSS is enabled: the function `HTMSS_StartTest` shall check for valid initialization. In case of failure `HTMSS_StartTest` shall raise the development error `HTMSS_E_NOT_INIT` and return E_NOT_OK.⌋

[SWS_HTMSS_00030]

Upstream requirements: SRS_HTMSS_00005, SRS_HTMSS_00006

⌈If DET for the HTMSS is enabled: the function `HTMSS_StartTest` shall check for the valid input parameter. In case of an error, `HTMSS_StartTest` shall raise the development error `HTMSS_E_PARAM_INVALID` and return E_NOT_OK.⌋

[SWS_HTMSS_00031]

Upstream requirements: SRS_HTMSS_00004

⌈If DET for the HTMSS is enabled: when called while a start request is already in place, is not in the state HTMSS_IDLE, the function HTMSS_StartTest shall raise the development error HTMSS_E_BUSY and return E_NOT_OK.⌋

8.3.3 HTMSS_GetTestStatus

[SWS_HTMSS_00032] Definition of API function HTMSS_GetTestStatus

Upstream requirements: SRS_HTMSS_00003, SRS_HTMSS_00004

⌈

Service Name	HTMSS_GetTestStatus	
Syntax	`HTMSS_TestStatusType HTMSS_GetTestStatus ( HTMSS_TestGroupType GrpId, HTMSS_TestResultType* RequestTestResultPtr )`	
Service ID [hex]	0x4	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	GrpId	The test group type (e.g. start up or shutdown)
Parameters (inout)	None	
Parameters (out)	RequestTestResultPtr	Pointer to store the request result
Return value	HTMSS_TestStatusType	–
Description	Returns current test status on requested test	
Available via	HTMSS.h	

⌋

[SWS_HTMSS_00033]

Upstream requirements: SRS_HTMSS_00003

⌈The function HTMSS_GetTestStatus shall collect the test status from the MSTP and store the read data in the out parameter RequestTestResultPtr, if OUT parameter is not a NULL_PTR and return HTMSS_TestStatusType with test status result.⌋

[SWS_HTMSS_00034]

Upstream requirements: SRS_HTMSS_00003

⌈If the OUT parameter is NULL_PTR, the function HTMSS_GetTestStatus shall NOT update the OUT parameter but shall return HTMSS_TestStatusType with the test status result.⌋

[SWS_HTMSS_00035]

Upstream requirements: SRS_HTMSS_00003

⌈The function `HTMSS_GetTestStatus` shall set the HTMSS state to `HTMSS_IDLE`, if the MSTP provided status confirm the test completion.⌋

[SWS_HTMSS_00036]

Upstream requirements: SRS_HTMSS_00003

⌈The function `HTMSS_GetTestStatus` shall provide the start up and shutdown test status depend on the input parameter `GrpId`.

Hint: The integrator/user shall ensure that a valid test status is readily available before invoking this API function.

Note: The methods/mechanisms to read/collect the requested test status are implementation specific and depending on the MSTP interfaces and microcontroller manufacturer specific guidelines.⌋

[SWS_HTMSS_00037]

Upstream requirements: SRS_BSW_00386

⌈If DET for the HTMSS is enabled the function `HTMSS_GetTestStatus` shall check for valid initialization. In case of failure `HTMSS_GetTestStatus` shall raise the development error `HTMSS_E_NOT_INIT` and return `HTMSS_STATUS_UNINIT`.⌋

[SWS_HTMSS_00038]

Upstream requirements: SRS_BSW_00323

⌈If DET for the HTMSS is enabled: the function `HTMSS_GetTestStatus` shall check for the valid input parameter. In case of an error, `HTMSS_GetTestStatus` shall raise the development error `HTMSS_E_PARAM_INVALID` and return `HTMSS_STATUS_INVALID`.⌋

8.3.4 HTMSS_GetVersionInfo

[SWS_HTMSS_00039] Definition of API function HTMSS_GetVersionInfo

Upstream requirements: SRS_BSW_00407

⌈

Service Name	HTMSS_GetVersionInfo	
Syntax	`void HTMSS_GetVersionInfo ( Std_VersionInfoType* versioninfo )`	
Service ID [hex]	0x06	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	None	
Parameters (inout)	None	
Parameters (out)	versioninfo	Pointer to where to store the version information of this module.
Return value	None	
Description	–	
Available via	HTMSS.h	

⌋

8.4 Callback notifications

None

8.5 Scheduled functions

None

8.6 Expected interfaces

In this chapter, all interfaces required from other modules are listed.

8.6.1 Mandatory Interfaces

This chapter defines all interfaces, which are required to fulfill the core functionality of the module.

[SWS_HTMSS_00040] Definition of mandatory interfaces required by module HTMSS

Upstream requirements: SRS_BSW_00384

⌈

API Function	*Header File*	*Description*
Mcu_GetResetReason	Mcu.h	The service reads the reset type from the hardware, if supported.

⌋

8.6.2 Optional Interfaces

This chapter defines all interfaces, which are required to fulfill an optional functionality of the module.

[SWS_HTMSS_00041] Definition of optional interfaces requested by module HTMSS ⌈

API Function	*Header File*	*Description*
Det_ReportError	Det.h	Service to report development errors.

⌋

8.6.3 Configurable interfaces

There are no configurable interfaces.

8.7 Service Interfaces

This chapter formally specifies the corresponding AUTOSAR service in terms of the SWC template. The interface described here is used to generate the RTE between application software and the HTMSS module.

8.7.1 Client server interface - GetTestStatus

[SWS_HTMSS_00042] Definition of ClientServerInterface GetTestStatus

Upstream requirements: SRS_HTMSS_00004

⌈

Name	GetTestStatus		
Comment	–		
IsService	true		
Variation	–		
Possible Errors	0	HTMSS_STATUS_OK	Test status PASS
	0	HTMSS_STATUS_NOK	Test status FAIL
	0	HTMSS_STATUS_UNINIT	Test status is not initialized
	0	HTMSS_STATUS_INVALID	Test status is Invalid

Operation	GetTestStatus	
Comment	Returns current test status on requested test	
Mapped to API	HTMSS_GetTestStatus	
Variation	–	
Parameters	GrpId	
	Type	HTMSS_TestGroupType
	Direction	IN
	Comment	The test group type (e.g. start up or shutdown)
	Variation	–
	RequestTestResultPtr	
	Type	HTMSS_TestResultType
	Direction	OUT
	Comment	Pointer to provide Test results along with Test
	Variation	–
Possible Errors	HTMSS_STATUS_OK HTMSS_STATUS_NOK HTMSS_STATUS_INVALID HTMSS_STATUS_UNINIT	

⌋

[SWS_HTMSS_91011] Definition of Port GetTestStatus required by module HTMSS ⌈

Name	GetTestStatus		
Kind	RequiredPort	***Interface***	GetTestStatus
Description	–		
Variation	–		

⌋

8.8 Callout Definitions

Callouts are code fragments that must be added to the HTMSS module during ECU integration. The content of most callouts is hand-written code. The HTMSS module configuration tool generates a default implementation for some callouts which is edited

manually by the integrator. Conceptually, these callouts belong to the ECU integration code.

Note: The error hook is an integration code to control the ECU processing in case of any tests failure.It may be a critical error for the system under development, so the integrator can react to the test failure (e.g. reset, halt, safe state)

8.8.1 HTMSS_StartupTestErrorHook

[SWS_HTMSS_00043] Definition of API function HTMSS_StartupTestErrorHook

Upstream requirements: SRS_HTMSS_00007

⌈

Service Name	HTMSS_StartupTestErrorHook
Syntax	`void HTMSS_StartupTestErrorHook ( void )`
Service ID [hex]	0x7
Sync/Async	Synchronous
Reentrancy	Non Reentrant
Parameters (in)	None
Parameters (inout)	None
Parameters (out)	None
Return value	None
Description	The ECU State Manager will call the error hook if the HTMSS provided startup test results have a failure. In this situation, the integrator has to control the CPU processing based on the system requirements, i.e. reset, safe state etc...
Available via	

⌋

8.8.2 HTMSS_ShutdownTestErrorHook

[SWS_HTMSS_00044] Definition of callout function HTMSS_ShutdownTestError Hook

Upstream requirements: SRS_HTMSS_00007

⌈

Service Name	HTMSS_ShutdownTestErrorHook
Syntax	`void HTMSS_ShutdownTestErrorHook ( void )`

▽

△

Service ID [hex]	0x8
Sync/Async	Synchronous
Reentrancy	Non Reentrant
Parameters (in)	None
Parameters (inout)	None
Parameters (out)	None
Return value	None
Description	The ECU State Manager will call the error hook if the HTMSS provided shutdown test results have a failure. In this situation, the integrator has to control the CPU processing based on the system requirements, i.e. reset, safe state etc...
Available via	HTMSS.h

⌋

9 Sequence diagrams

9.1 Sequence diagram example of HTMSS Initialization

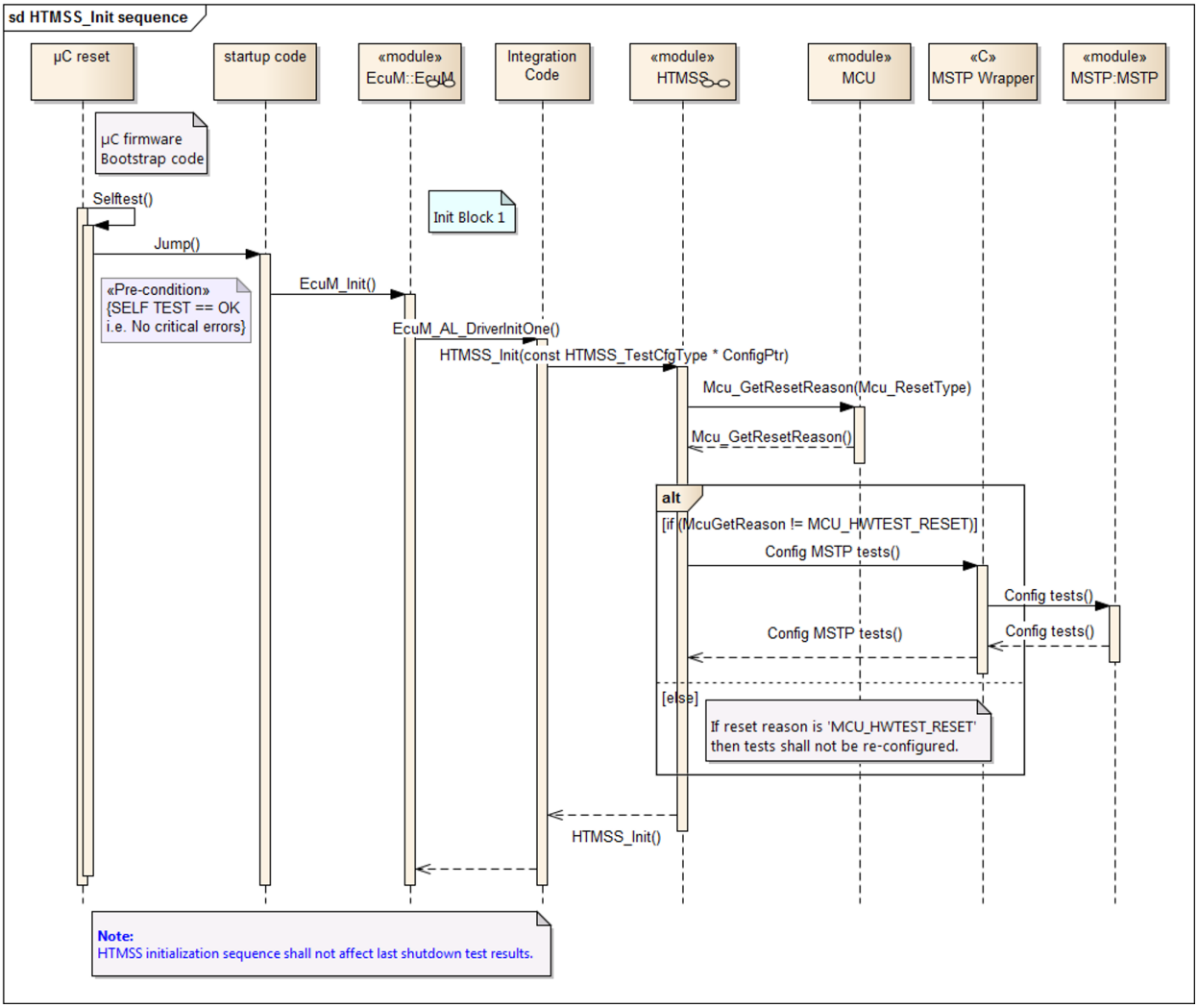

Figure 9.1: HTMSS Initialization

9.2 Sequence diagram example of startup test execution

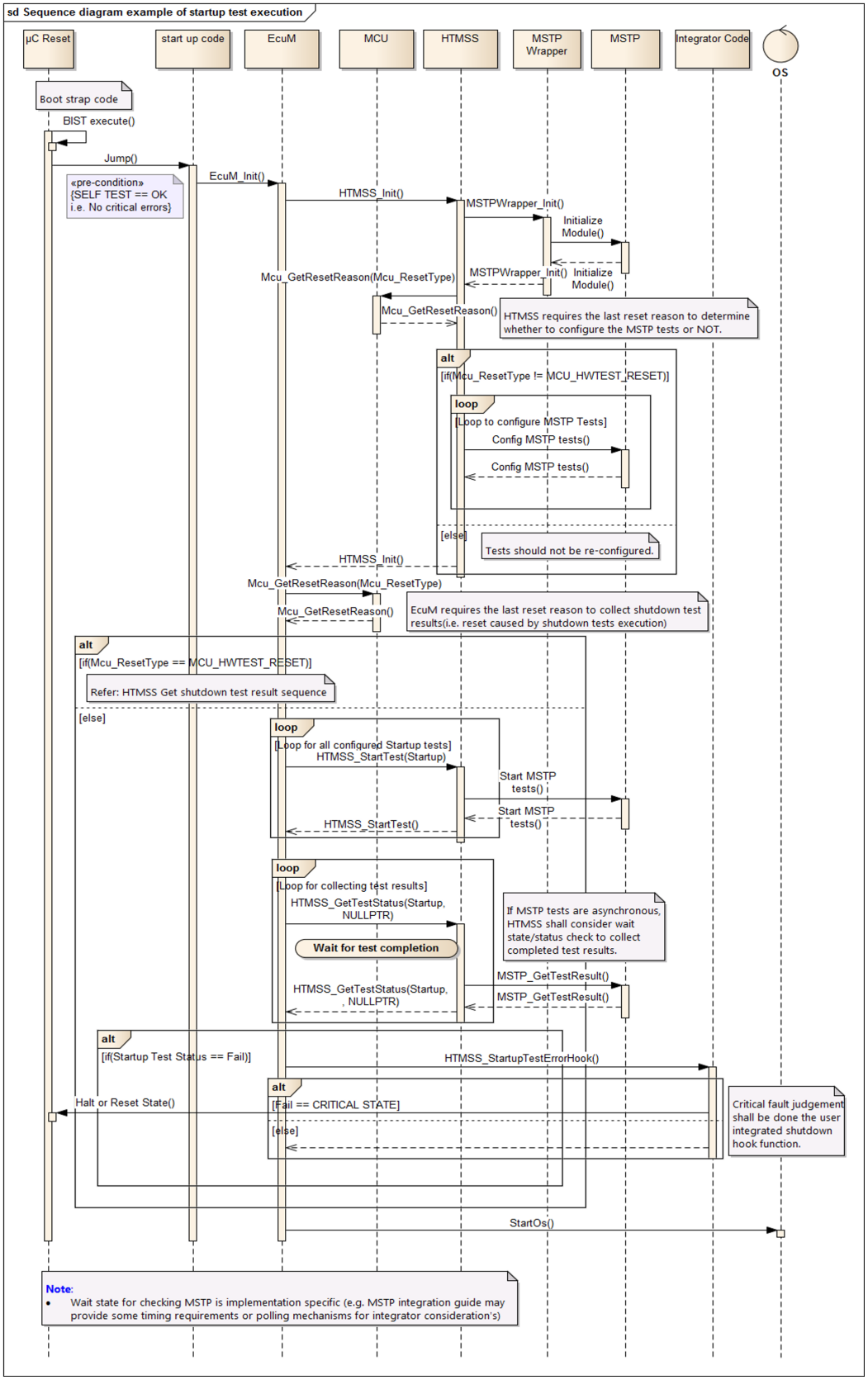

Figure 9.2: Startup test execution

9.3 Sequence diagram example of shutdown test execution

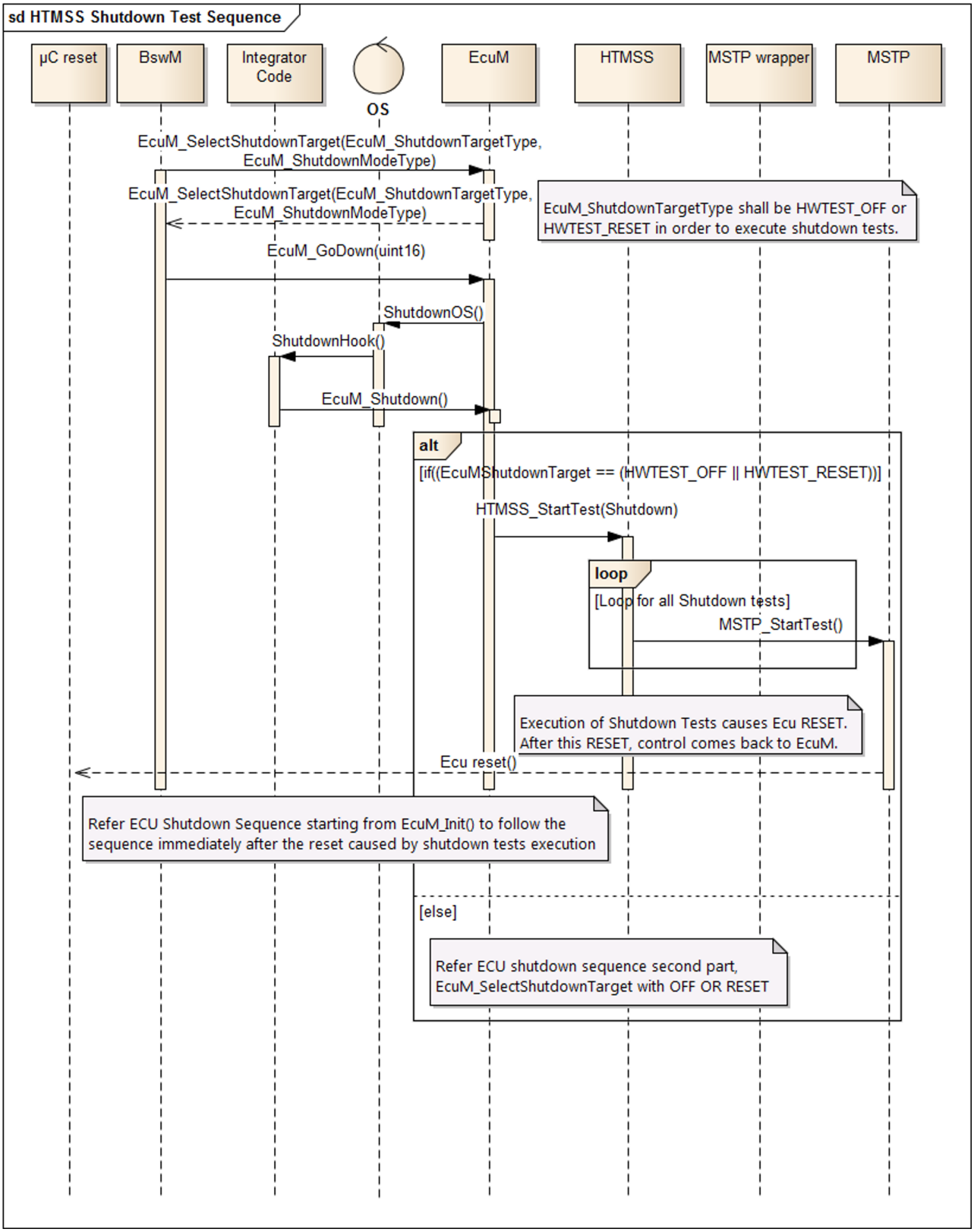

Figure 9.3: Shutdown test execution

9.4 Sequence diagram example handling the last shutdown test results immediately after the ECU reset raised by MSTP module

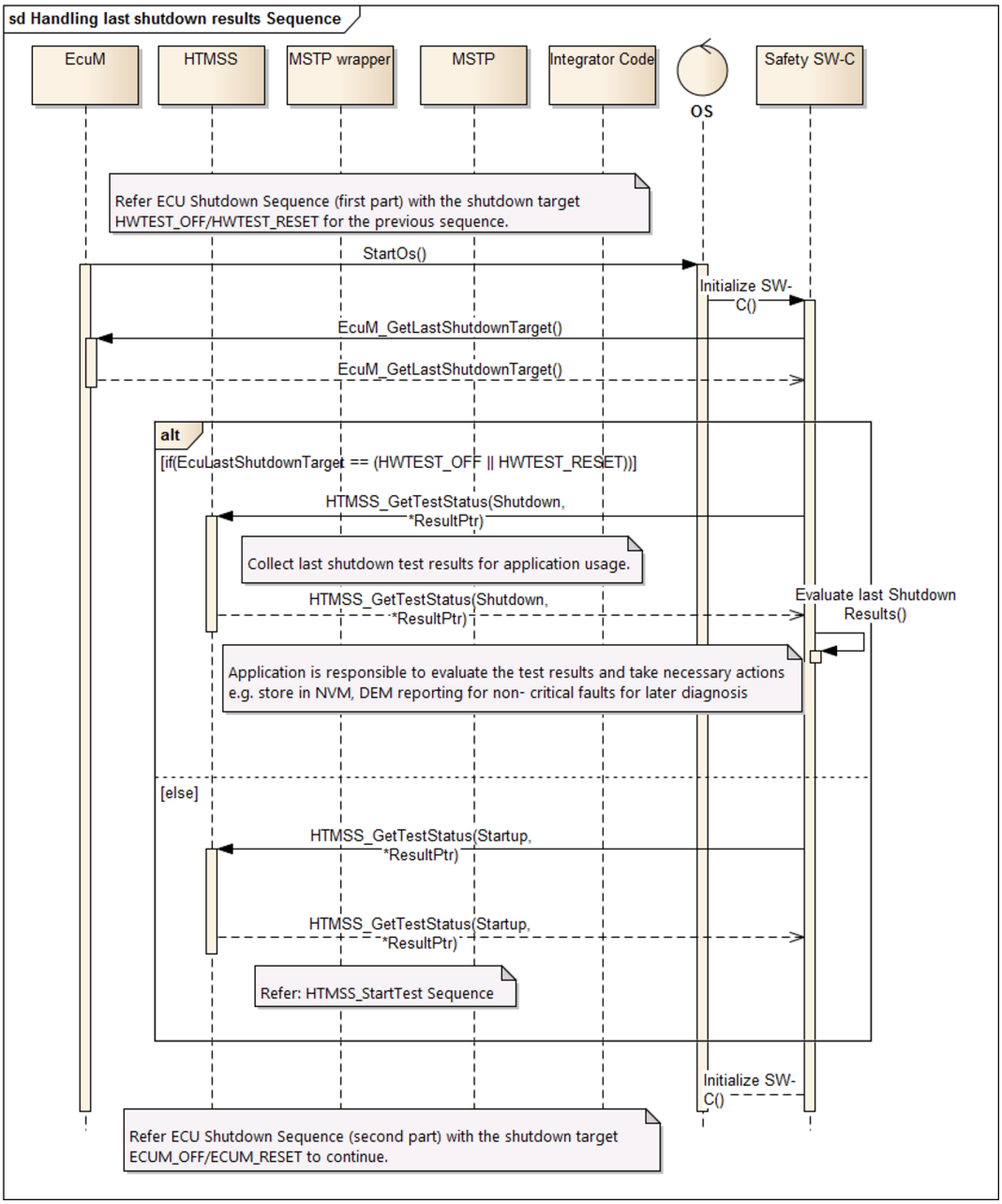

Figure 9.4: Handling the last shutdown test results

9.5 Sequence diagram example of collecting the shutdown test results

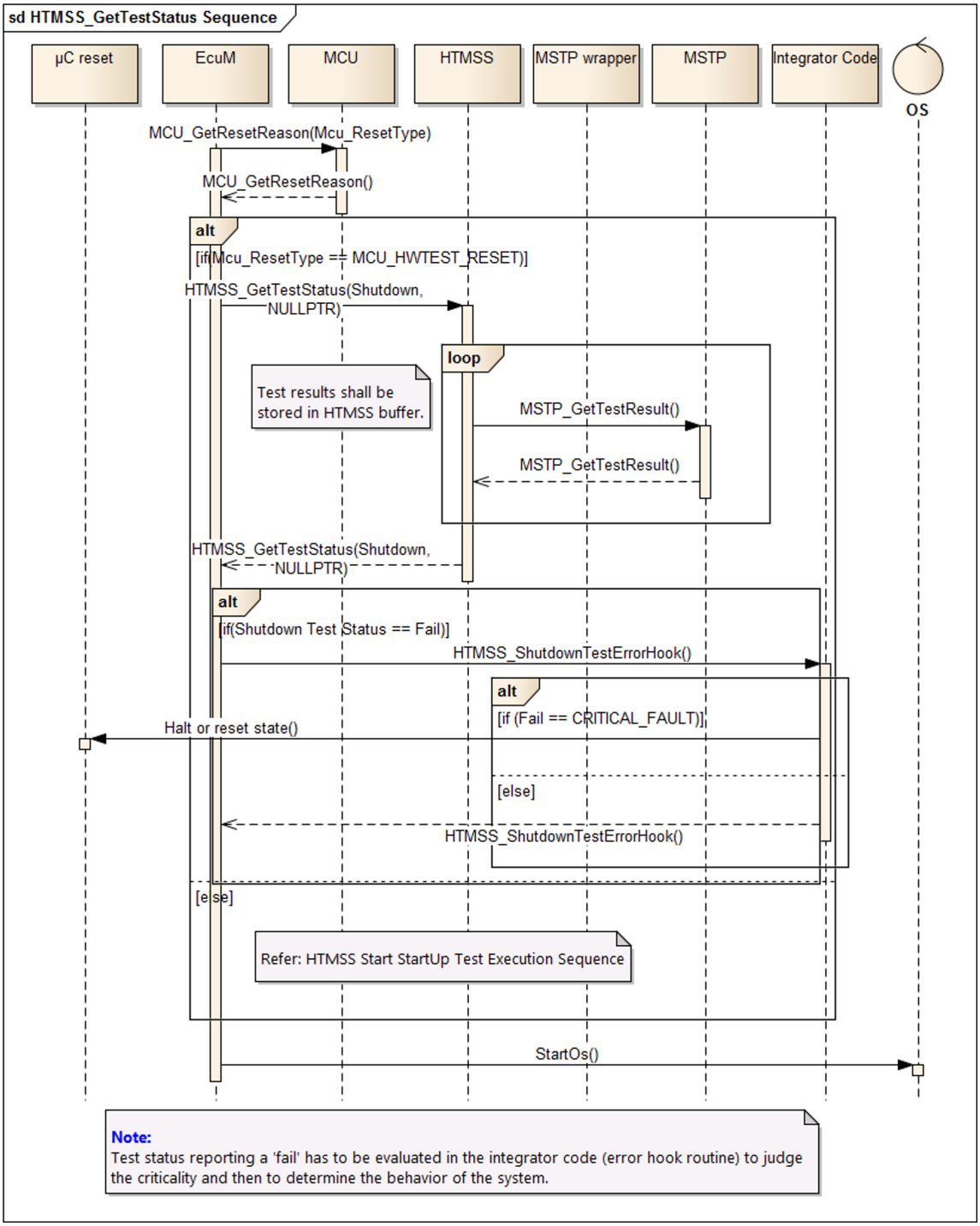

Figure 9.5: Collecting the shutdown test results

9.6 Sequence diagram example of ECU shutdown when HTMSS is integrated in the system

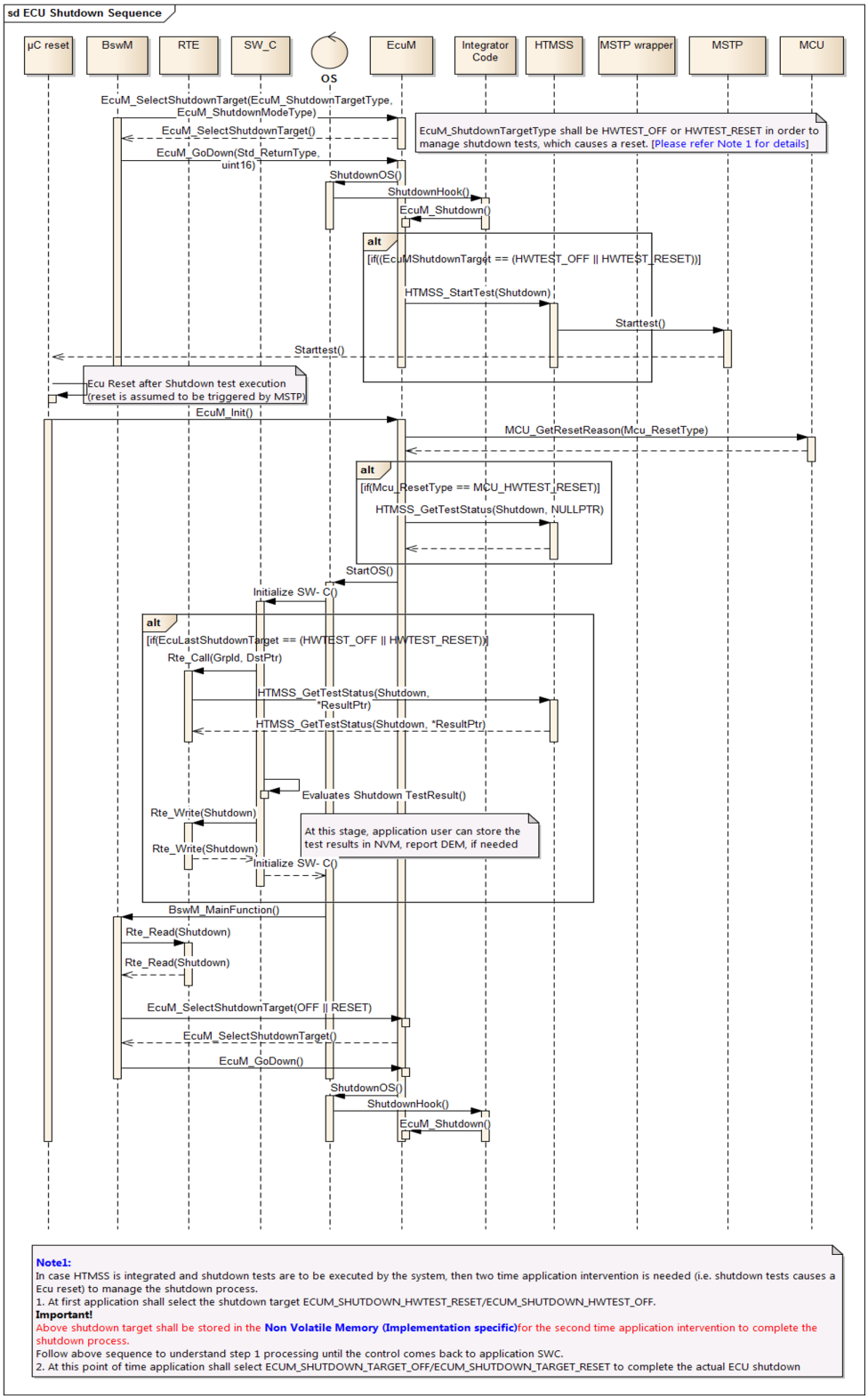

Figure 9.6: ECU shutdown with HTMSS integrated

9.7 Sequence diagram example of application SWC collecting the test results

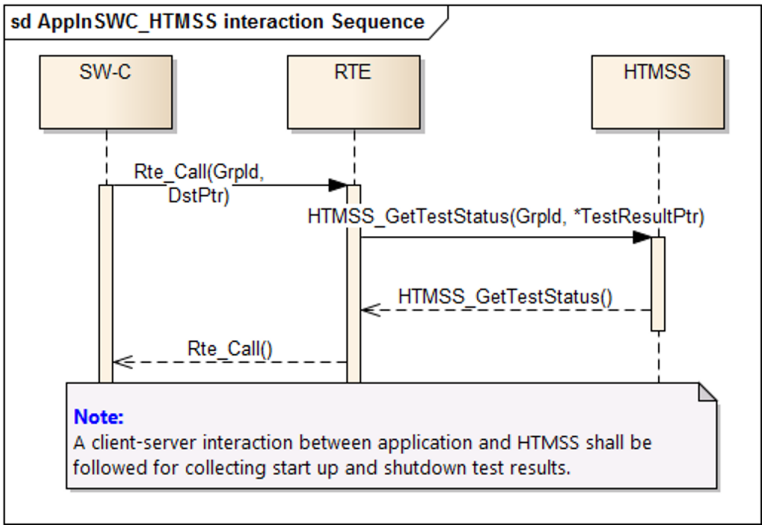

Figure 9.7: Application SWC collecting the test results

10 Configuration specification

The following chapters summarize all configuration parameters. The detailed meanings of the parameters are described in the Chapters below.

10.1 Containers and configuration parameters

The following chapters summarize all configuration parameters. However, the content of this chapter is, intended to provide as an example for reference purposes.

The actual implementation is up to the specification user.

10.1.1 HTMSS

[ECUC_HTMSS_00001] Definition of EcucModuleDef HTMSS ⌈

Module Name	HTMSS
Description	Configuration of the Hardware Test Management start up and shutdown (HTMSS) module.
Post-Build Variant Support	false
Supported Config Variants	VARIANT-PRE-COMPILE

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
HTMSSConfigSet	1..*	This is the base container that contains the configuration parameters & sub containers of HTMSS module.
HTMSSGeneral	1	This container holds the general parameters of the HTMSS module.

⌋

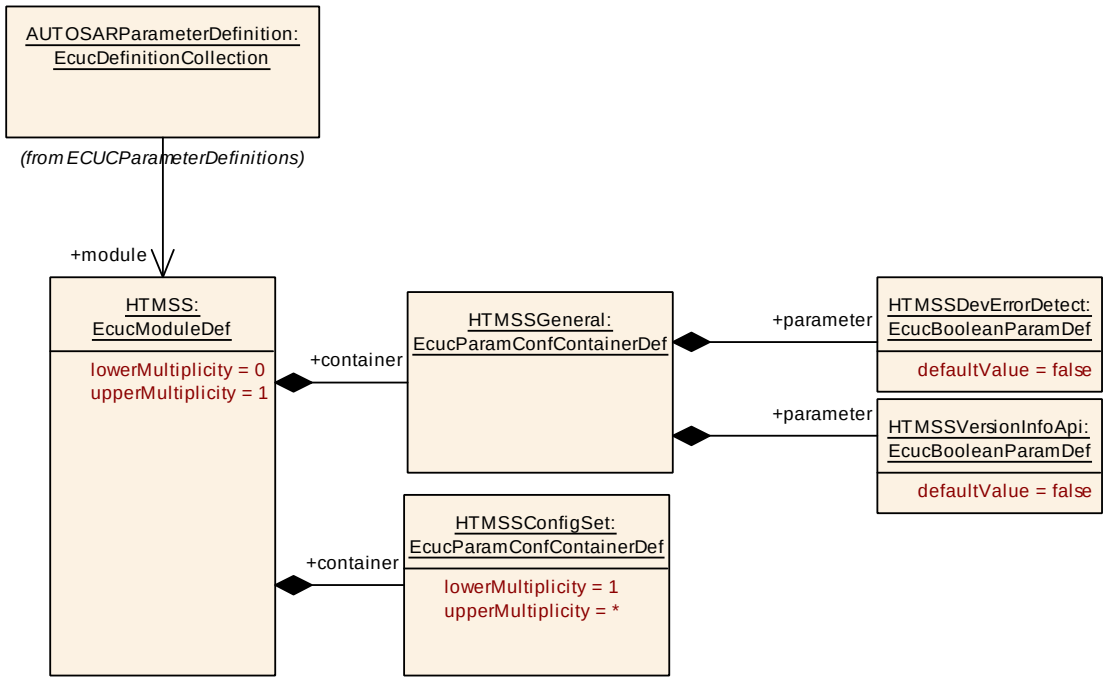

Figure 10.1: HTMSS ECUC Parameters

10.1.2 HTMSSGeneral

[ECUC_HTMSS_00619] Definition of EcucParamConfContainerDef HTMSSGeneral ⌈

Container Name	HTMSSGeneral
Parent Container	HTMSS
Description	This container holds the general parameters of the HTMSS module.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
HTMSSDevErrorDetect	1	[ECUC_HTMSS_00002]
HTMSSVersionInfoApi	1	[ECUC_HTMSS_00003]

No Included Containers

⌋

[ECUC_HTMSS_00002] Definition of EcucBooleanParamDef HTMSSDevErrorDetect ⌈

Parameter Name	HTMSSDevErrorDetect		
Parent Container	HTMSSGeneral		
Description	Switch for enabling the DET.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_HTMSS_00003] Definition of EcucBooleanParamDef HTMSSVersionInfoApi ⌈

Parameter Name	HTMSSVersionInfoApi		
Parent Container	HTMSSGeneral		
Description	Activate/Deactivate the version information API.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

10.1.3 HTMSSConfigSet

[ECUC_HTMSS_00012] Definition of EcucParamConfContainerDef HTMSSConfigSet ⌈

Container Name	HTMSSConfigSet
Parent Container	HTMSS
Description	This is the base container that contains the configuration parameters & sub containers of HTMSS module.
Configuration Parameters	

No Included Parameters

No Included Containers

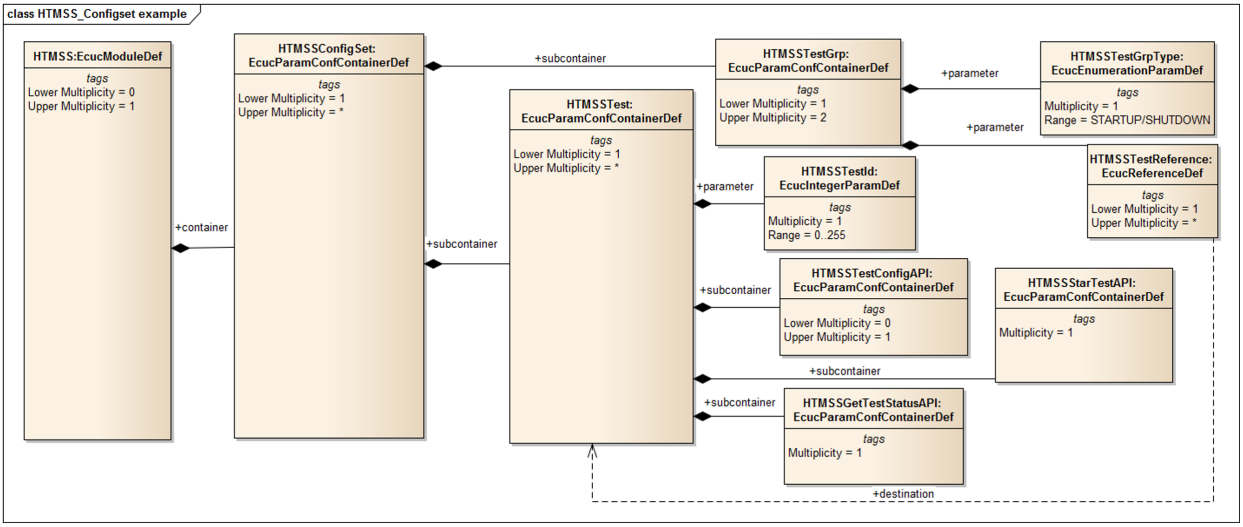

Figure 10.2: HTMSS Configuration

10.2 Published Information

For details refer to the chapter 10.3 “Published Information” in [5].